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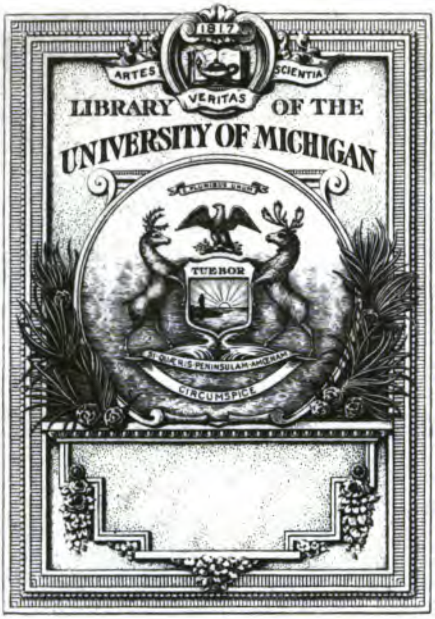

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GEOLOGICAL SURVEY OF HOKKAIDO.

THE

GOLD FIELDS OF YESSO.

A REPORT

BY

HENRY S.mith MUNROE, E.M.,

Professor of Geology and Mining in the Imperial College, Tokio;
and formerly, Assistant Geologist and Mining Engineer
to the Kaitakushi of Hokkaido.

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TOKIO, JAPAN, 17th May, 1875.

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GENERAL HORACE CAPRON,
Commissioner and Adviser
to the Kaitakushi.

SIR:

I have the pleasure of transmitting to you the careful and elaborate report of Mr. Munroe on the Gold Fields of Yesso; and have the honor to be,

Sir,
Your most obedient Servant,
BENJ. SMITH LYMAN,
Chief Geologist and Mining Engineer
to the Kaitakushi.

TOKIO, JAPAN, May 10th, 1875.

Mr. BENJ. S. LYMAN,
Chief Geologist of Hokkaido.

SIR : I have the honor to report the following results, obtained in the examination and survey of the more important Gold Fields of the Island of Yesso. This report includes the detailed results of the gold-washing, and of the topographical surveys, with an outline of the geology of each field. A more complete description of the characteristic rocks, with the thickness and arrangement of the different beds, will be given in another place.

The report also includes the results of the examination of numerous so-called copper, lead, and silver mines—visited incidentally while traveling from one gold field to another.

Respectfully submitted,

HENRY S. MUNROE.

THE TOSHIBETSU GOLD FIELD.

THE TOSHIBETSU GOLD FIELD.

This gold field is situated on the head-waters of the Toshibetsŭ, or Toshi river, which empties into the Japan Sea, between the small towns of Setanai and Fŭtoro, in the province of Shiribeshi, on the west coast of southern Yesso. The gold field, however, is in the province of Iburi, and is most easily reached from the east coast; by leaving the shore of Volcano Bay at Kunnui, and following the valley of the Kunnui river; from the head of which a road, or rather bridle-path, leads across the hills to the Toshibetsu.

The Toshibetsu, in this part of its valley, flows between high hills, about one thousand to twelve hundred feet above the sea, or eight to nine hundred feet above the river.

The bottom of the valley lies in three, or in some places four, distinct terraces; respectively twelve to fourteen feet, thirty to fifty feet, eighty to ninety feet, and two hundred and fifty to two hundred and seventy feet above the river. These terraces are remarkably uniform, falling in level with the fall of the river, and keeping always about the same relative height to each other, and to the bed of the stream.

The lowest of the terraces is formed entirely of gravel, with a covering of sand and clay, the bed-rock being often below the level of the stream.

The next two terraces are covered with gravel, apparently deposited by running water, usually about nine to twelve feet thick, and covered by several feet of yellow sand and soil. The bed-rock is far above the present level of the stream, seeming to indicate a recent elevation of the land in this part of the island, and a consequent deepening of the valley by erosion.

The highest terrace is also covered by gravel, perhaps thirty or forty feet thick, and overlaid by fifty feet of yellow sand and clay. Neither the gravel, nor the bed-rock, are anywhere well exposed, so that these measurements are somewhat approximate. Even the presence of gravel was only discovered by digging for it.

Before entering upon the details of the work of the survey, it may be well to give an outline of the geological relations of the rocks found in the valley. These rocks may be divided into four groups. Arranged with the newest first, we shall have.

1st. *Alluvial or Terrace formations.*—Including the auriferous gravels with their overlying beds of sand and clay. These beds of gravel, both of the river plain and of the higher terraces, have been deposited in running water, as before noticed; which fact is shown by the arrangement of the materials, and particularly by the position of the imbedded flat stones, which overlap one another, being uniformly inclined, and having their lowest edge up stream. The stones in the bed of any swift stream, may be seen to be arranged in a similar manner, being thus in the most stable position to resist the overturning and transporting power of the swift current. The former direction of the old current, as shown by the position of these flat stones, does not differ materially from the course of the present river.

2nd. *Volcanic Rocks*—in large veins or massive eruptions, penetrating, (and overlying ?) the stratified rocks in several .places.

3rd. *Stratified rocks*, very recent.—These are about 3,000 feet thick, and at first were placed in one group, the "Toshibets;" but they may be perhaps better divided into two, of which the newer alone, clay rocks and tufas, belong to the Toshibetsu Group ; while the less recent underlying shales and sandstones, may be styled the Chingkombe Group. The former reach a thickness of over two thousand feet, and are made up of beds of clay rock, pumice-tufa, soft sandstones and conglomerates. The latter group is over a thousand feet thick, and is composed of beds of harder shales and sandstones. The material of the rocks, of both groups, is almost exclusively volcanic ; pumice, either in fragments or as a sand, entering largely into the composition of all. Even the "clay rocks" are fusible before the blowpipe. The lower sand stones of the Chingkombe group alone, are largely made up of debris of the underlying granite ; and even these are found to contain pumice in greater or less proportion.

The Toshibetsu group lies in the form of a broad basin, corresponding with the valley of the river. The strata on the eastern side of the basin, dip gently toward the west ; but on the western side the beds are highly inclined, dipping to the east. The general direction of the basin is about north and south, plunging to the southward.

The Chingkombe shales underlie these strata on the east side of the valley, having a similar strike and dip, but apparently not quite conformable. They do not appear on the west within the limit of the survey, though found in full thickness a short distance down the river.

4*th*. *Granitic rocks*, which occur in a high hill, "Tapkop," on the east side of the valley, underlying the stratified clay-rocks and shales.

GOLD WASHING.

To test practically the richness of the gold-bearing gravel; large measured quantities of the same, were carefully washed by the Japanese method, and the resulting gold weighed on a delicate assay balance.

At the outset, several other plans for making these practical tests suggested themselves. The "pan," the favorite of the gold "prospector" in almost all parts of the world, was tried; but on account of the extreme poverty of the gravel, the results were of little value, as only small quantities could be washed at once, which yielded at times little or no gold, and again, from the same locality, gave very large and flattering results. From selected samples, taken carefully from the bedrock, very promising amounts of gold were sometimes obtained, even in the poorer parts of the field.

It became therefore necessary to devise some plan, by which larger quantities of gravel, taken from the whole thickness of the deposit, could be washed without too much trouble. The "sluice," now used in one form or another, wherever large quantities of gravel are to be washed for gold, could not be employed, on account of the time, labor, and expense, of making the necessary boxes, and putting them in position; and the difficulty of moving the apparatus from place to place, in testing various parts of the field.

The "cradle," said to be used by Chinamen in California, in reworking the old "dump heaps" and "tailings;" was tried by Mr. Blake (on Ponkuroiwa), when he visited the Toshibetsŭ, but the results do not seem to have been very satisfactory; and I was informed that a larger percentage of gold was obtained by the Japanese method, from the same place, and at the same time.

I therefore decided to test the value of this Japanese method, by comparing it with the work of the "long tom." This apparatus was used in California many years ago, but was abandoned in favor of the "sluice." The long tom is practically a very short sluice, and is therefore not adopted for saving fine gold; but it is much better than the cradle, and it was thought that it might compare very favorably with the Japanese method.

The experiments were made purposely under conditions least favorable to the long tom, the gravel washed being very poor, and the gold fine. The results show a surprising difference in favor of the Japanese method.

In one case, washing with a limited supply of water; one cubic metre of gravel yielded, by the native method, thirty and eight-tenths milligrammes of gold; while the long tom saved but two and six-tenths milligrammes, or about one-twelfth part. In a more favorable locality, washing three cubic metres of gravel in each case, the Japanese method yielded at the rate of sixty-eight milligrammes to the cubic metre; while the long tom gave but eighteen, or only about one quarter.

In favorable localities, and with more practised workmen, undoubtedly much better results might be obtained; but the above experiments showed, that for our work of prospecting in poor gravels, the Japanese method was certainly the best, as well as the most convenient.

Modification of Japanese Method used.—The Japanese method requires but few tools, viz: a "tsuru," or pick, for occasional use in loosening the gravel; two or three special shaped "kua," or hoes, for working the gravel in the stream or washing ditch ; a "joren" or scoop-shaped bamboo basket for removing the coarse gravel ; two or three "nekoza" or straw mats specially made for collecting the gold ; and an "ita" or board, slightly warped and dish-shaped, used as a "pan" for separating the gold from the concentrated sand.

To these were added a measuring box (or "masu"), made to hold exactly one half cubic metre, and provided with a floor of boards, to ensure accuracy of measuring. Also a couple of shovels were used for filling and emptying this box.

To test the gravel of any desired locality ; a place was selected on a small stream, satisfying, if possible, the following conditions ;

1st.—An exposure of the bedrock below the gravel, at least six inches, or a foot, higher than the level of the stream.

2nd.—The whole thickness of the gravel-bed accessible.

3rd.—A velocity of at least one and a-half or two feet per second: either in the stream itself; or obtainable in a washing ditch, fifteen or twenty feet long, by a dam or other expedient.

4th.—Sufficient water for washing. Sixty to eighty cubic feet per minute, is the most convenient amount, but much less can be used.

A suitable place found ; the bank is cleared of grass, roots, and soil, for a width of about three feet, and from the bedrock to the top of the bank, exposing the whole thickness of the gravel bed.

The measuring box is then placed in position on the bank of the stream, and filled with gravel, only boulders of exceptional size being omitted. In the meantime the gold washers form a washing ditch ; by cleaning the bed of the stream, for a width of two or three feet and a length of fifteen or twenty. When the stream is large it is divided, only the amount of water requisite for washing being admitted to the ditch. In thus dividing the stream, care must be taken that the stones of the dividing wall are so placed, that all leakage of water is from the main stream into the ditch, and that there is no flow of water outwards ; otherwise much of the measured gravel, with its gold, will be lost.

These preparations completed, the gravel is shoveled from the measuring box into the head of the washing ditch, and the box refilled with gravel. At the same time, the gold-washers wash, and throw out, the large stones by hand ; and separate the smaller stones from the gravel with the "joren" and "kua." The rapid current washes out all the clay and fine sand, leaving only the fine gravel in the stream. Riffles, built of flat stones, are put across the lower end of the ditch, to arrest the gravel, and to prevent any gold from being carried down stream.

When from four to six boxes of gravel, have been shoveled into the water, forming a bed of fine gravel about a foot thick, the washing on mats begins. Two or three mats, each one foot wide by two feet long, slightly narrower at the lower ends, are placed side by side across the stream, about two feet below the upper end of the gravel. The upper edges of these mats are buried slightly in the gravel, and held in position by the foot of the gold washer, usually one man to each mat, the number of mats being regulated by the width of the stream.

These men now carefully hoe the gravel to the head of the mats, so that it shall be carried over their surface by the force of the current. The heavy gold and iron-sand sink between the thick twisted strands of straw, forming the mat, while the lighter gravel passes down stream. The lower ends of the mats are from time to time lifted, and folded over the upper portion ; to transfer the gold to the head of the mat, and to keep the lower part clean.

When all the gravel in front of the mats, has been hoed over their surface ; the men move them about two feet down stream, and begin to work in a similar manner, on the new portion of gravel thus exposed.

Finally, after twenty-five or thirty minutes work, the mats are removed, one by one, from the bottom of the stream ; folded in both directions under water, to transfer the material to the middle ; and then bent in a trough-like form, and "jigged" with a longitudinal motion, under the water, to separate the lighter sand and gravel which still remains. One of the mats is then held in the stream, between the ankles of the gold washer ; folded lengthwise as a trough, through which the water is allowed to flow quietly. A second mat is then seized by the ends, inverted, and folded transversely, the fold being allowed to dip just below the water in the trough of the mat below. The mats are so woven that this folding opens the crevices between the large transverse strands, allowing the gold and iron sand to be washed out by the water. By alternately raising each end of the mat, while depressing the other, the whole surface is successively washed by the stream ; and the various strands of the mat being opened, and loosened, by the folding, the gold and iron sand are very completely transferred to the lower mat. In a similar way, the concentrated material from all the mats is collected on one ; and from this is finally transferred to the shallow wooden washing board. This last transfer is made with great care, in a quiet pool of water ; in which place the final concentration, on the board, is effected.

The separation of the gold from the iron-sand, on this board, requires great care and skill. The board is first floated on the water, and by a few oscillating motions, the material is washed to the centre. Then it is raised from the water, with a number of smart longitudinal jerks ; the effect of which is to bring the heavier material to the end next the gold-washer, while the lighter sand flows off gradually with the water at the lower end. The board is now brought to the surface of the water, the lower end dipping a little below, and with one or two gentle swings it is again covered with water, while a small quantity of light sand is washed from the lower end. The board is now raised, with the same dextrous shakes as before: the washing being conducted with great care, and but little iron sand being allowed to pass off each time. After five or six minutes, most of the gold will have been brought to the head of the board, the bright yellow grains showing very distinctly in the black sand. The gold may be brought more clearly into view, by allowing a little water to trickle down the inclined board, which washes off the black sand, and leaves the gold exposed.

This first portion of gold, with some of the adjoining iron sand, being removed; the remaining sand is then washed a few times, usually yielding one or two grains in addition.

Finally, the gold, and the small quantity of iron sand taken from the board at the same time; having been dried, are submitted to a careful separation by blowing, the iron sand is carried off, and the gold remains, ready for weighing. In this last separation, a small magnet is sometimes of assistance, in removing large grains of iron sand, too heavy to be blown away.

Samples of gravel were thus washed from the following places in this field.

1.—*Upper Toshibetsü.* Gravel was taken from the main terrace on the east side of the valley, very near the northern limit of the survey. The gravel here is only four to six feet thick, and is covered by eight to ten feet of sand and clay. The bedrock, olive-green clay-rock, is about twenty feet above the level of the small stream, in which the gravel was washed. The gravel is entirely concealed, by the thick bed of sand which covers it; and it was only after considerable trouble, that we succeeded in getting a small sample for washing.

The gravel of this vicinity has been extensively worked in former times, the remains of old ditches being very numerous. At the first place uncovered, the gravel looked as though it might have been disturbed, so that another excavation was made on the opposite side of the valley, where the gravel seemed thicker. At this latter place, after digging through five or six feet of sand we struck the gravel, but for want of time, were not able to reach the bedrock.

One quarter cubic metre, from the whole thickness of the bed of gravel, at the first place; yielded forty-four and two-tenths milligrammes of gold, or at the rate of one hundred and seventy-six and eight-tenths milligrammes to the cubic metre.

One eighth cubic metre, from the upper two feet of the gravel-bed, at the second place; yielded 11.9 milligrammes of gold, or at the rate of 95.2 milligrammes to the cubic metre.

The average yield of the two samples would be about 136 milligrammes to the cubic metre.

An average collection of pebbles, of medium size, taken at random; gave the following percentage of the different rocks; which represents about the composition of the gravel:

Quartz	34
Quartzite and Metamorphic Sandstone	19
Granite and Gneiss	29
Mica Schist	4
Talcose Schist	3
Chlorite Schist	11
	100

Mr. Kitagaki, who visited this field, in company with Admiral Enomoto, in the summer of 1872; washed a sample of gravel on this same stream, but farther down, from the low river terrace.

2.—*Akabuchi.* Another sample of gravel was taken from the main terrace, on the west side of the upper valley; on the bank of this stream, and about four *cho'* (¼ mile) in a straight line, from its mouth. This small valley is lined with a net work of old-ditches and waste heaps, indicating very extensive ancient workings. It was found impossible to secure a suitable place for testing the gravel, where it had not already been washed; so that we were forced to be content with a place where the bed-rock was reported to be about five feet below the surface of the stream. Three cubic metres of gravel yielded 342.8 milligrammes of gold, or at the rate of 114.3 milligrammes to the cubic metre.

About eleven years ago, Saiyemon, the gold-washer employed by our party, worked in this same place for the government of the Shogun, having five or six men as assistants. The work was continued about two years and a-half; in which time about two hundred and forty, or two hundred and fifty *momme* of gold* were obtained, from a limited area.

While working actively, the yield was at the rate of two and a half *momme* per month, for each man employed, worth perhaps five and a-half *yen.* Much time, however, was necessarily lost in unprofitable work, cutting ditches, etc.

Admiral Enomoto, when he visited this field, washed a sample of gravel from this same vicinity, but farther down the stream. His sample was not taken from the main terrace, but from a small and local deposit in the ravine; thus testing gravel derived from the terrace above, but probably somewhat concentrated by the action of the stream.

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* 895 to 932 Grammes, or about 30 ounces.

3. *Kuusube.*—This sample was also taken from the western main terrace : on the north bank of the Kuusube, a large stream which empties into the main river below Akabuchi, and nearly opposite the old office building. The place tested is about ten *cho* (¾ mile) from the mouth of that river, measured in a straight line.

Abundant evidences of the work of the old gold-washers, are to be found on the sides of this stream, the adjoining terrace being in many places covered with a labyrinth of old ditches. A large supply ditch was apparently dug, from the upper part of the Kuusube, near the western limit of the survey, and carried over the main terrace for more than twenty *cho* (about one and a-half miles) to the main river ; following along the base of the third terrace in the lower part of its course. Then, by branch ditches, the water was led over the field where wanted ; and the gravel of the terrace washed by the regular Japanese method. Work on a similar plan can be traced in the Akabuchi valley ; but in this place, apparently from want of water, (as they used only that to be obtained from the small stream itself) the upper part of the valley was not touched.

In two places on the Kuusube, the government washed for gold on a small scale, at the same time as the operations on Akabuchi. The first place is about three *cho* in a straight line from the mouth of that stream, and the other five *cho*. Six men were constantly employed, and the yield per man was about the same as on Akabuchi.

Mr. Enomoto, on the visit already alluded to, washed for gold at a point about seven *cho* (½ mile) from the mouth of the stream, where the main line of the present survey crosses the Kuusube.

Our sample was taken farther up stream, about ten *cho* from the mouth, from the northern bank. There are no old gold workings in this vicinity, and the gravel is apparently undisturbed. The bed-rock is about a foot above the level of the stream, and the bed of gravel about seven feet thick.

The composition of the gravel, as shown by an average collection of pebbles, is as follows :

Quartz (impure)	6
Quartzites (showing stratified structure)	17
Metamorphic Sandstones	17
Granitic rock	15
Mica Schist	20
Chlorite Schist	14
Talcose Schist	2
Volcanic rock	3
Soft clay shales (bedrock)	6
	100

The position of the flat stones in the gravel, being examined; they were found to dip to the north, or ten to fifteen degrees west of north. It would seem therefore, that the current that deposited this bed of gravel was more nearly parallel to the main river than to the course of the present Kuusube. This would seem to indicate that the gravel and gold were brought down by the upper Toshibets, but more measurements will be necessary to establish this.

Three cubic metres of gravel from this place yielded 234.6 milligrammes of gold, or at the rate of 78.2 milligrammes to the cubic metre. It will be seen that this result indicates a much poorer gravel than that of Akabuchi; while the gold-washers, when working for the old Government, obtained here about the same amount as on that stream. If we suppose the gold to be derived from the upper Toshibetsŭ, this is easily accounted for, Our sample, being taken farther up stream, than the working place of the gold-washers, is consequently farther from the main valley, and would naturally be somewhat poorer.

However, the size of the grains of gold is said to increase as we ascend the Kuusube, so it may be that some of the gold is derived from the upper part of this stream, as well as from the upper valley of the Toshibetsŭ.

4. *Highest Terrace.*—This terrace, 250 to 270 feet above the river, is everywhere covered by a thick bed of yellow sand; making the attempt to reach the gravel, to determine its thickness, and to secure a sample for washing, quite difficult.

Several holes were dug on the slope of the terrace; under the direction of one of the assistants, Mr. Inagaki, and the gold-washer, Saiyemon; with the following results. The first attempt was made on the slope of the terrace, near station (M. 387 t,) on the main line, about forty feet below the level of the plain. The hole was dug through about eight feet of fine yellow sand, and then a stake was driven, about two and a half below the bottom, but without resistance. Another hole was then made near (M. 366 s,) uncovering the bed-rock at a point about eighty-seven feet below the general level of the terrace. This may not be the highest level of the bed-rock, but the true level cannot be far above. A third excavation was made near stake (M. 416 w.) forty-four feet below the level of the terrace, passing through eight. (?) feet of sand and clay, and striking gravel at the bottom. The excavation was continued a foot and a half in the gravel, when the work had to be abandoned on account of an accumulation of water in the hole. From this it would appear that the gravel is thirty-five to thirty-seven feet thick, and is covered by fifty to fifty-two feet of yellow sand and clay.

Several samples of the yellow sand, one litre each, were taken from the first hole dug, and washed, but yielded no gold.

Two like samples of blue gravel, taken from the second excavation, from the bedrock, were also tested by washing; one yielded nothing, while the other gave two small grains of gold, weighing less than one tenth of a milligramme. This would perhaps give an average of about fifty milligrammes, or less, to the cubic metre.

5. *Okajisawa.*—This sample was taken from the main terrace, on the west bank of this stream, about six and a half *cho* from its mouth. The bedrock is here about seven feet above the stream and the excavation was carried eighteen feet above this, the whole height being gravel. The level of the terrace is still ten or fifteen feet higher, a large proportion of which thickness is probably sand. Three cubic metres of this gravel yielded 204 milligrammes of gold, or at the rate of 68 milligrammes to the cubic metre.

The "Long Tom" was tested at this place, saving only about one quarter as much gold, from the same amount of gravel.

6. *Ponkajisawa.* The gravel washed on this stream, in the vicinity of the last mentioned place, was purposely taken from some old heaps of gravel washed by the ancient gold washers, who have left abundant traces of their work in the neighborhood. This waste-heap was tested, with a view to determine how much gold might be obtained by reworking such deposits. The result is not encouraging. One cubic metre of gravel yielded but 30.8 milligrammes of gold, in excedingly fine grains.

The "Long Tom" was also tested here, as already noted, but with very poor results as compared with the work of the Japanese process, saving but one twelveth as much gold.

7. *Chingkombe.*—One cubic metre of gravel was taken

from the low terrace, in the valley of this large stream, which runs through the south-eastern section of the survey. The sample was taken from a point about five and a-half *cho* above the mouth. The bedrock is here a little above the level of the stream, and the bed of gravel is about five feet thick. One cubic metre of gravel on being washed yielded but 3.4 milligrammes of gold.

An attempt was made to work with the "Long Tom" at this place, but it was not successful, for want of sufficient head of water; although the water was taken one hundred and fifty feet up stream, and led by means of an old ditch, and wooden spouts, to the place of work. The total fall thus obtained was four feet, which was diminished to three feet, by the time it reached the apparatus, at which point we should have had at least three and a-half feet. This shows the great adaptability of the Japanese process to varying conditions; and its superiority, as a means of prospecting, to the Long Tom; for in this one hundred and fifty feet, there were several places, where the Japanese method might have been used to test the gravel of the bank.

8. *Nisheumubetsu.*—This sample was washed to test the gravel of the Pirikabetsu valley. The Pirikabetsu is an important branch stream, entering the main river about opposite Kuusube, and just below the narrower, and richer, portion of the main field that I have called the "upper valley."

The Pirikabetsu has high and broad terraces on either side, corresponding to the terraces of the main valley, but the gravel appears to be almost entirely barren. The sample tested was taken from the main terrace about two thousand feet below the upper limit of the survey; on the west side of the branch stream, Nishemubetsu, and on a small brook emptying into that stream.

The gravel here is five feet thick, and covered by three feet of soil and clay. The composition of the gravel, determined as usual, is about as follows :

Soft Sandstone...	...75
Clay shale	... 2
Quartz	...12
Feldspathic rock	... 2
Granitic rock	... 3
Metamorphic Sandstone	... 3
Chlorite Schist (?)	... 3
	100

One cubic metre of this gravel, yielded five very minute grains of gold, weighing less than one tenth of a milligramme.

The following table gives a summary of the results thus obtained, by washing measured quantities of gravel, in the different parts of this field. In measuring, no allowance has been made for the increase of bulk, due to the loosening of the gravel, and to the vacant spaces, necessarily left between the stones, in filling the measuring box.

The gold obtained, was weighed on a delicate assay balance, in grammes and decimals of a gramme ; and the first column contains the results, already given, reduced to a uniform bulk of one cubic metre of gravel. The figures in the other columns, were obtained by simple arithmetical calculations.

In these calculations the following values were employed, derived from various sources ; and verified, where possible, by actual experiment.

One riu-tsubo = 216 cu. shaku = 6.0492 cu. metres.
„ „ = 7.6126 cubic yards.
One momme = 3.7298 grammes.

One momme of pure gold is worth 2.36 yen. (Osaka mint value, 1874.)

The market price of pure gold was also given me at two and a half yen per momme ; but the value here used, 2.36 yen, probably better represents the true average value, as it is said to be the standard price paid by the Osaka Mint.

A blowpipe assay, on a small quantity of gold sand from this field, yielded nine hundred and forty parts of pure gold per thousand. One momme of gold sand, at the mint value, would thus be worth two yen and twenty-two and a-half sen, (2.22½ yen) which value was used in calculating the figures given in last columns of the table.

TABLE I, TOSHIBETSU GOLD FIELD, IBURI PROVINCE.

Sample of Gravel Tested.	*Grammes of Gold per Cubic Metre.*	*Momme of Gold per Riu-tsubo.*	*Value of cub. met. in cents.*	*Value of riu-tsubo in sen.*	*Value of one cu. yd in cents.*
1. Upper Toshi.	0.1360	0.2205	8.11	49.06	6.13
2. Akabuchi ...	0.1143	0.1854	6.81	41.25	5,16
3. Kuusube ...	0.0782	0.1268	4.66	28.21	3.53
4. Highest Terrace	0.0500	0.0800	3.00	18.00	2.25
5. Okajisawa ...	0.0680	0.1102	4.06	24.52	3.07
6. Ponkajisawa ...	0.0308	0.0500	1.84	11.12	1.40
7. Chingkombe ...	0.0034	0.0055	0.20	1.22	0.15
8. Nisheumbetsu	0.0001	0.0002	0.01	0.04	0.01
Average*	0.0835	0.1354	5.00	30.12	3.77

The poorest gravel worked in California, by the hydraulic process, yields five to ten cents to the cubic yard ; while the average is said to be twenty-five to thirty-five cents. These are the thick gravel deposits, fifty to two hundred and fifty feet thick. Thin placers, like the Toshibetsu field, are usually much richer. In view, however, of the cheapness of labor in Japan, it may be that this field can be worked ; indeed it seems quite probable that the upper-valley, averaging seven and a-half cents to the cubic metre, or five and two thirds cents to the cubic yard, will even yield a profit; more especially as water can be had in abundance through the whole season, and at very slight expense for ditches and flumes.

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* Average obtained from 1, 2, 3, & 5; giving four times the weight to 3 and 5; as to 1 and 2, these representing the larger area. 1 & 2 together representing but 1/5 of the valley.

The following sources of extra expense, however, must be considered; as it is quite possible that any one of them may consume all the profits otherwise certain.

1st.—The inefficient labor, which makes two or three men necessary to do the work of one.

2nd.—The thinness of the beds of gravel, entailing the expense of frequent extension or displacement of flumes and ditches.

3rd.—The expense of cutting the dense growth of bamboo, and of disposing of its mass of matted roots.

4th.—The extra expense due to the remains of ancient workings, the nearly barren gravel of which, may have to be rewashed in certain cases, to get at the unworked ground.

TOPOGRAPHICAL SURVEY.

* * * * * * * * * *

The survey of the field was made by the rectangular plan, as adopted at Kaiyanoma and ,other places. The lines of the survey, run by prismatic compass, and measured by pacing, were checked by more accurate lines run carefully with the transit, with stadia measurements. One such line formed the main line of the survey; while two others, at right angles to this, were run parallel to the paced side lines, and served as a measure of their true direction and length.

* * * * * * * * * *

The errors of this style of survey (by prismatic compass and pacing) are necessarily large—though not so great as might perhaps be expected. The errors tend to balance each other—so that the final inaccuracy is usually quite small.

I add a table, showing the results of the comparison referred to above, in the case of each of the paced lines. The letters in the first column, refer to the name of the assistant, and the numeral to the number of his line.

TABLE II. ERRORS OF PACED LINES. TOSHIBETSU.

Line.	*Errors in "side" line:*		*Errors in "tie" line:*	
	in direction.	*in length.*	*in direction.*	*in length.*
1 H.	¾°	— 0.6 %	0°	— 0.6 %
2 H.	2°	—17.0 %	½°	—21.0 %
3 H.	0°	— 5.0 %	½°	— 2.5 %
1 I.	0°	0.0 %	0°	+ 1.0 %
2 I.	1¼°	+ 2.0 %	⅓°	— 2.0 %
3 I.	¼°	0.0 %	0°	0.0 %
4 I.	0°	— 2.0 %	0°	0.0 %
5 I.	¼°	— 2.0 %	0°	— 2.0 %
1 N.	1°	+ 1.5 %	¼°	+ 6.0 %
2 N.	1½°	+ 5.0 %	1⅙°	+ 5.0 %
3 N.	0°	+ 0.7 %	0°	+ 0.7 %
4 N.	0°	— 0.3 %	0°	— 0.5 %
5 N.	1°	— 1.0 %	¼°	— 0.3 %
1 B.	½°	+ 1.0 %	½°	+ 1.0 %
2 B.	0°	0.0 %	0°	0.0 %
3 B.	2½°	0.0 %	0°	0.0 %
4 B.	0°	— 0.4 %	0°	— 1.0 %
5 B.	0°	— 1.8 %	0°	— 1.8 %
1 K.	0°	— 1.0 %	1°	— 1.0 %
2 K.	½°	+ 4.0 %	0°	+ 4.0 %
3 K.	1½°	+ 4.0 %	1°	+ 4.0 %
4 K.	½°	— 2.5 %	0°	+ 1.2 %
5 K.	½°	— 3.0 %	0°	+ 3.0 %
6 K.	0°	— 4.2 %	0°	+ 4.2 %

* * * * * * * * * *

Area of terraces.—By measurement we find the total area of the bottom of the valley, including all the ground covered by gold bearing gravel, to be about

9,674,000 square metres.

The area of the main terraces, which includes all of the land best adapted for gold washing, (embracing both the 30 feet and the 80 feet terraces) is about

5,305,000 square metres.

The area of the low river terrace and bottom land; which although quite as rich as the main terrace, will be more difficult to wash, the bedrock being often below the level of the stream; is about

200,000 square metres.

The area of the high terrace and terrace slopes; surface covered with gravel, but quite poor or thin, and not available for washing; about,

169,000 square metres.

And finally, the area of the ground already worked, covered with old ditches, most of which lies on the main terraces. This I cannot determine exactly, but roughly estimate it at about

160,000 square metres.

These areas do not include the upper part of the Chingkombe valley, which several tests, on small quantities of gravel, show to be barren; nor the Pirikabetsu valley already shown to be very poor.

From this we see that there is available for gold washing, after deducting the ground already washed, about

5,145,000 square metres

or, taking the average thickness of gravel on these terraces at three metres,

15,435,000 cubic metres.

This would be, however, too poor to be washed with profit, yielding but five cents to the cubic metre or only three and three-quarters cents to the cubic yard.

If the upper valley alone were washed, we should have available about

800,000 square metres or,
2,400,000 cubic metres of gravel.

yielding seven and a half cents per cubic metre : giving a gross yield of gold worth.

180,000 *yen.*

To extract this amount of gold would cost ; say, 100,000 *yen* and leave a profit of perhaps 80,000 *yen* to be obtained in five to ten years work ; depending on the number of men employed.

These estimates of cost and profit, are of course only very rough guesses ; but in view of the numerous conditions which enter into the problem, which can only be determined by actual trial—such for instance, as the cost, per cubic metre, of disposing of the bamboo—it will be hardly possible to estimate more exactly.

Volume of water in the various streams.—A few rough measurements were made to determine the volume of the different streams in the valley ; with a view to ascertain how much water may be made available for gold washing. The results are given in the following table, expressed in cubic feet of water delivered, by each stream, per minute.

TABLE III, VOLUME OF WATER, TOSHIBETSU.

Toshibetsu—above Akabuchi (estimated)	7,500 cu. ft.
Akabuchi	150
Pirikabetsu (estimated)	4,200
Kuusube	2,850
Kuroiwa, and small streams (estd.)	300
Toshibetsu—below Kuroiwa	15,000 cu. ft.
Okajisawa, and small streams (estd.)	600
Chingkombe	1,800
Toshibetsu below Chingkombe (about)	17,400 cu. ft.

Of this amount, the water of the upper Toshibetsu, (certainly under-estimated) and of the Kuusube, can easily be diverted into ditches, at such a height as to command all the gravel of the field. We should thus have available, something more than ten thousand cubic feet of water per minute, or enough to supply ten or twelve large hydraulic workings, and to wash seven and a-half to nine thousand cubic metres of gravel per day.

Timber.—The whole valley is wooded, though the growth is nowhere dense. Some of the trees are quite large. The proportion of good building timber is small, neither pine nor cedar occurring in any quantity, though said to be obtainable at no great distance. Nearly all the trees are hard wooded, and best adapted for firewood.

Stone, Building material.—The only stone suitable for building found in this valley is granite ; unless possibly some of the lower sandstones of the Chingkombe group, made up of the debris of granite, may be available, these however stain quite badly on exposure. The granite, where exposed in place, is almost always soft and crumbling, but an abundant supply of building stones may be secured from the large boulders in the bed of the streams.

A small quantity of lime could be made from the concretions of limestone, which occur in the red shales of the Chingkombe group. These concretions occur as loose boulders in several places, having been washed out of the shales by the action of the river.

KUDO GOLD FIELD.

KUDO GOLD FIELD.

On leaving the Toshibetsŭ Gold Field I was instructed to proceed down the Toshi river to the west coast; and along that coast to Kudo and Esashi, near which places gold was reported to occur.

On the voyage down the river, the Toshibetsu series of clay rocks and the underlying shales and sandstones were traced for a long distance both to the south and west. These strata were usually dipping westward, and the total thickness seems to be nearly five thousand feet. In the lower valley all rocks are concealed by a thick bed of river alluvium, and near the mouth only a small exposure was seen; clay rock underlaid by a hard sandstone, and covered by volcanic rock.

The coast, between the mouth of the river and Kudo, presents some exceedingly fine exposures of volcanic and metamorphic rocks, to be more fully described in another place.

About one ri (2½ miles) south-east of the village of Kudo, two large streams, the Mōshibetsŭ and the Usubetsŭ, empty into the Japan Sea about three or four *cho* (¼ mile) apart. The valley of the more northern and smaller stream, the Mōshibetsŭ, runs nearly north and south, and is quite narrow, only one or two *cho* wide at the bottom; while the valley of the larger stream, the Usubetsŭ, runs at first north-eastward from the coast, and then about east and west. This valley is much wider, varying from one *cho* to four and a-half.

The gravel, said to be gold-bearing, occurs only at the bottom of these small valleys, the high marine terrace above showing only yellow alluvium, sand and clay. There are no terraces proper within these valleys, only a flood plain, five to eight feet above the river.

Survey.—A hasty survey of these streams was made by the assistants, with prismatic compasses, the distances being measured roughly by pacing, and the contours of the hills merely sketched. From the map, resulting from this survey, it seems that the valley of the Moshibetsu contains about

288,000 square metres

of gold-bearing gravel, while the Usubetsu valley, so far as surveyed, contains

1,240,000 square metres.

Taking the average thickness of the gravel at one and a-half metres, this would give respectively:

Moshibetsu... ...	432,000 cubic metres.
Usubetsu	1,860,000 cubic metres.
Total ...	2,292,000

In both valleys the bedrock is concealed, being somewhat below the present bed of the stream; but from several trials I am convinced that the gravel is at least as thick as given above—perhaps even thicker.

Gold Washing.—The gravel of each valley was carefully tested by washing large samples from very favorable situations. Two cubic metres were washed in each case, the method employed being the same as that used on the Toshibetsu, and described in the account of that field.

The results obtained are given in the following table:

Table IV. Kudo Gold Field. Shiribeshi Province.

Sample of Gold washed.	*Grammes of Gold per Cubic Metre.*	*Momme of Gold per Riu-tsubo.*	*Value of 1 cu. m. in cents.*	*Value of Riu-tsubo in sen.*	*Value of 1 cu. yd. in cents.*
1. Moshibetsu ...	0.0070	0.0114	0.42	2.50	0.30
2. Usubetsu ...	0.0011	0.0018	0.07	0.40	0.05

1. *Moshibetsu.*—Two cubic metres of gravel washed. Bank five feet high; upper two feet soil; excavation carried two feet below water; total thickness of gravel tested, therefore, equals five feet. Gravel coarse, containing some large stones. Gold quite fine, some grains almost microscopic.

2. *Usubetsu.*—Two cubic metres of gravel washed. Terrace four feet above water level, upper two feet fine brown sandy soil. Three feet of gravel washed, the lower foot below the level of the stream. Gold very fine; grains smaller than the above.

These results agree very well with those obtained by the gold-washer, Saiyemon, the year before; when he tested the gravel of other places in these same valleys.

The small amount of gold obtained, is enough to prove that gold exists in the gravel of these rivers, but certainly in too minute quantity ever to be of any value.

The bedrock varies in different parts of the field, volcanic rock predominating. Near the sea, on the Usubetsu, we have soft clay rocks and tufas; and in the Moshibetsu valley, older shales and sandstones appear underlying these rocks, and associated with volcanic dykes and overflows. The geological relations of the rocks of these valleys are very interesting, and will be described more fully in another place.

The gravel is wholly made up of metamorphic and volcanic rocks, and contains little or no quartz. An average collection of the pebbles yielded:

Light green tufa rock (hard)	47
Sandstones	12
Slate (?)	5
Mica Schist	1
Granitic rock (Syenite or Porphyry)	12
Volcanic rock	23
Total	100

The source of the minute proportion of gold in this gravel, is probably within the limits of the survey, as gold is not found in the upper parts of these valleys. It is possible that it may come from a slaty rock, which is found in places penetrated by minute seams of quartz.

Coal.—While examining these gold deposits, my attention was called to some thin beds of coal, which occur in the shales at the upper end of the valley of the Mōshibetsŭ.

The section of the rocks exposed with the coal is as follows.

Laminated dark greenish brown shale	4.4 ft.
Poor coal, with much pyrite,	0.3 to 0.4 ft.
Blue clay rock,	0.7 to 0.5 ft.
Coal, very bony,	0.3
Argillaceous sandstone,	0.7 to 0.3
Fire clay, gray,	4.0
Coal, soft,	0.3
Sandstone, brown, argillaceous,	0.6 +

The clay parting between the upper beds disappears in one place, the two seams uniting to a bed 1.4 ft. thick.

The coal is exposed on both sides of a small saddle or anticlinal, the elevation being apparently due to a dyke of volcanic rock, which forms the dividing ridge, and breaks through the coal rocks. The strike of this dyke is the same as that of the shales, fifty degrees east of north. The coal rocks dip thirty degrees south-east, and forty-degrees to the north-west, away from the volcanic rock on each side.

This deposit of coal is so thin and bad, as to be quite worthless; but the fact that the strike of the rocks is the same as that of the coal rocks of the Kayanoma field, is not without interest.

Copper.—In a hard, fine grained, light green tufa rock, near the eastern limit of the survey, in the small valley of the stream Yunosawa; there is a thin lenticular (?) vein of quartz holding blende, copper pyrite and erubescite. This vein has been explored by a small drift for about nineteen feet. It varies in thickness from 0.5 to 0.2 ft., but is mainly quartz and blende, holding but a small quantity of the copper minerals. Near the end of the tunnel, the vein pinches out to nothing, at the bottom, though continuing about the same thickness at the top.

Eight feet below this tunnel, and near the level of the stream, another smaller drift was begun on the same vein; evidently intended as a drainage level and air-way; but was continued but two or three feet.

This vein of copper ore is nowhere rich enough to pay for working, and it seems doubtful if it continues for any great distance beyond the end of the present tunnels. In view of the fact that it is apparently the only deposit of the kind in the vicinity, it will be hardly advisable to push the exploration farther.

ESASHI GOLD FIELD.

ESASHI GOLD FIELD.

While in Kudo we learned that gold had been found in several of the valleys near Esashi. Proceeding to that place we noticed that the gravel of all the streams, from a point about four *ri* north of that town, was composed of sandstones and metamorphic rock, holding a large percentage of quartz. The gravel of the Otobe river, three *ri* (7⅓ miles) before Esashi, was tested in one or two places in passing; but only a minute proportion of gold was obtained, enough however to show that the field contained gold, though unfortunately not in paying quantities.

A similar gravel, apparently auriferous, was observed in places on the top of the marine terrace, usually covered with a thick bed of sand and clay.

Arrived at Esashi we learned that the valley of the Jimikishi, a stream emptying into the sea within the limits of the town, was supposed to be the richest gold field in the vicinity. This supposition afterwards proved to be quite correct, as will appear on inspection of the results obtained.

During the few days we remained in Esashi, the assistants spent the time in surveying this Jimikishi valley, while the gold-washers were employed in washing for gold on that stream, and in other valleys of the district.

Gold Washing.—Samples of gravel were washed at the following places.

1. *Otobe river,* a large stream three *ri* (7½ miles) north of Esashi, already referred to. The gravel of this stream was tested at a point ten *cho* (¾ mile) above the mouth. The gravel washed was not measured, but estimated at about one quarter cubic metre. The bedrock was not reached, as the river is now running above the level of its old bed ; not only higher than the bedrock, but in most places even above the bed of gravel. Thickness of gravel unknown, upper one and a half feet only washed. Yield one half milligramme of gold, or about two milligrammes per cubic metre.

2. *Jimikishi river.*—At station (M. 878 r) twenty *cho* (1½ miles) from mouth of the river. Gravel measured in the bank, about one cubic metre. Bedrock, decomposed mica-schist, three feet above level of stream. Bed of gravel, eight feet thick, covered by one and a-half to two feet of brown sand. Sample taken from lower five feet. Gravel contains a good proportion of large stones, one cubic foot and more in size.

An average collection of pebbles yielded :

Quartz	12
Quartzite	13
Gneiss	6
Mica Schist	15
Talcose Schist	7
Sandstone	34
Slaty shale	10
Volcanic rock (pumice)	3
	100

Gold comparatively course, in flat grains. One cubic metre yielded 29.0 milligrammes.

3. *Jimikishi river.*—Near station (N. 552 v.) twenty-four and a half cho (1¾ mile) from mouth. Two cubic

metres of gravel washed. Bed of gravel three and eight-tenths feet thick, and covered by two feet of soil. Bed-rock six and a half feet above the stream. The whole thickness of the gravel was washed: yield 8.8 milligrammes or about 4.4 milligrammes to the cubic metre.

4. *Gokatte kawa.*—A small stream at the south end of the town. Sample taken at a point about ten *cho* ¾) mile) from the mouth of the stream. Bank about five feet high of which the upper two feet is soil. Bedrock not reached (?) One half cubic metre of gravel washed, yielding but one minute grain of gold, weighing about one-tenth milligramme; showing that the land is much more valuable, as utilized, for market gardens than it ever could be, as a gold field.

5. *Todo river.*—One and a half *ri* from Esashi to the south. Bed of gravel about four feet thick, of which one foot is below water. Gravel covered by one and three tenths feet of soil. Bedrock reached, one foot below the water; and one cubic metre of gravel taken, from the whole thickness of the bed. The resulting gold very fine, weighing one and two-tenths milligrammes, Valley narrow, about five hundred feet wide, and cultivated. Stream large; fifteen to twenty feet wide at this point.

6. *Mena river.*—A large stream two *ri* (five miles) south of Esashi. Gravel tested at a point one and a half *ri* up stream. Valley here quite narrow, but the river, even as far up as this, flows some distance above its original bed. Bedrock not found. One cubic metre of gravel was taken from a bank about five feet high, and the excavation was continued below water level but without reaching bed-rock. The gold obtained was exceedingly fine. One cubic metre of gravel yielded but eight-tenths milligrammes of gold. An average specimen of the gravel yielded.

Quartz	17
Quartzite	7
Talcose schist	3
Mica schist	19
Gneiss	3
Slate, &c.	7
Red schist (?)	4
Sandstone	40
	100

The rocks of this part of the valley are mica schists, quartzites, &c. Near the sea these are overlaid by modern tufas and clay rocks, as in the lower Jimikishi valley.

The following table gives a resumé of the results obtained:

TABLE V. ESASHI GOLD FIELD. OSHIMA P.

	Sample of Gravel washed.	*Grammes of gold per cu. metre.*	*Momme of gold per Riu-tsubo*	*Value of 1 cu. m. in cents.*	*Value of 1 Riu-tsubo in sen.*	*Value of 1 cu. yd. in cents.*
1	Otobe	0.0020	0.0032	0.12	0.71	0.09
2	Jimikishi	0.0290	0.0473	0.73	10.46	1.31
3	Jimikishi	0.0041	0.0071	0.26	1.58	0.20
4	Gokatte	0.0002	0.0003	0.01	0.07	0.01
5	Todo	0.0012	0.0019	0.07	0.42	0.05
6	Mena	0.0008	0.0013	0.05	0.29	0.04

It will be seen that the gravel of this gold field proves to be exceedingly poor, far too poor to be worked; not only in the unfavorable cases where it was found impossible to reach the bedrock, but even under the most advantageous conditions, as on the Jimikishi. Even were this not the case, it would be exceedingly difficult to work these deposits. The larger rivers are all extremely sluggish, often losing themselves in swamps, and even when followed nearly to their source, the fall is still quite gentle. By the Japanese process, it would be impossible to carry on properly, any large washing operations in the lower parts of these valleys ; as the bedrock is in many places below the sea level, or so little above as not to give sufficient fall to the ditches. Even in the smaller valleys, or in the upper part of the large streams, it would be difficult to keep the bedrock in sight, as these sluggish streams would rapidly become silted up by washed gravel, raising the level of the river above. To work these deposits by sluicing, would require expensive elevated flumes to give the necessary fall, and the gravel would have to be raised to the level of these sluices by mechanical power, entailing an expense only warranted by very rich ground.

The gravel, already mentioned, on the terrace between the rivers, might be worked without difficulty, but it is probably even poorer than that of the valleys ; as this latter, originally of the same richness, has been undoubtedly much concentrated by the action of the streams.

Topojraphical Survey.—The survey of the Jimikishi valley was finished at about the same time as the gold washing. The course of the river was run by prismatic compass, and the distances approximately measured by pacing, as in the Kudo survey. The height and slope of the hillsides were determined by lines across the valley, the levels being taken by repeated barometric readings. Sights on the hills, taken with the compass, aided the plotting of the topography, which was copied from sketches taken in the field. The result is a rather more accurate map than that of the Kudo field, but as the paced distances are not checked in any way, there may be considerable inaccuracy in this regard.

From this map it would appear that the main valley is 32½ *cho* long (2¼ miles) and from forty *ken* to three and

a half *cho* (240 feet to $\frac{1}{4}$ mile) in width. It contains
578,000 square metres
of bottom land, covered with an average of 1.8 metres of gravel.

While at Esashi we were informed of gold fields, then being worked, in the vicinity of Matsumai; said to be quite rich. Owing to the lateness of the season, and to the fact that the lead mines at Yurap were still to be surveyed, it was decided to put off the examination of the Matsumai fields, and to proceed at once to Yurap.

The survey of the Yurap mines was only partially finished, when we were ordered to Hakodate, and it has not been completed since. The results of the examination of the old mines at that place, and of the study of the geological relations of the rocks, will be given elsewhere.

MATSUMAI GOLD FIELDS.

MATSUMAI GOLD FIELDS.

PROVINCE OF OSHIMA.

On taking the field last year, I was ordered to proceed to Matsumai, and to test the richness of the gold fields in that vicinity; visiting at the same time any deposits of useful minerals to which my attention should be called by the Japanese officials of the province.

In the immediate vicinity of Matsumai, there are a number of gold-fields of small extent; from which, it is said, large amounts of gold have been taken by gold-washers from the south, some six or seven hundred years ago. These fields were visited, but found to be entirely exhausted.

The road from Hakodate leads along the sea shore to Shiriuchi, thence up the valley of the Musa river, and across the Shiriuchidake to the coast, and so to Matsumai. In passing through the Musa Valley, I was struck by the appearance of the gravel in the streams, and covering the high terraces in either side; and was not surprised to learn, on inquiry, that party of gold-washers from Matsumai, had been working here the previous season.

On reaching the town of Matsumai, or "Fukuyama", we found the gold-washers to whom we had been directed from Hakodate, and learned that this Musa Valley was the gold field referred to by our informants. Accordingly after spending a few days at Fukuyama, we returned to the Musa, making our head quarters at Ichinowatari.

Lead Mines.—My attention was called to some veins of lead ore at Akagami, about one *ri* from the coast on a small stream about two and a half *ri* north-west of Fukuyama. At this place we found several old exploring tunnels, which have been abandoned for many years. The lead ore occurs in small veins associated with blende, pyrite, &c. The fissures are in some places as much as a foot in width but the seams of ore are rarely more than one or two *sun* (0.1 to 0.2 ft.) thick. The predominating mineral is zinc blende; galena, the ore of lead, occurring in small proportion, and pyrite in still smaller amount.

A sample of the washed lead ore, (galena) was tested for silver, but found to contain but a trace of that metal.

These veins are neither large enough, nor sufficiently numerous, to pay for working. Their chief interest lies in their resemblance, on a small scale, to the lead bearing veins at Yurap; and to similar deposits now worked at Daira, in Akita ken, on the main island.

The veins have a nearly east and west direction (N. 80° W., dipping 70° to 80° S.) traverse a dark blue quartzite, and are associated with a white quartzose porphyry (?); in all these points, and in the character of the ore, resembling the veins of Yurap and Daira.

Silver ore, so-called,—While in Fukuyama a specimen of lead, said to have been derived from the smelting of a newly discovered silver ore, was brought to my hotel. On assaying the lead I found it to contain about six and a quarter per cent of silver! and accordingly I visited the place and secured samples of the ore. This discovery was made near Kurodaki, on Kazamisan-no-sawa, between Fukuyama, and Fukushima, some little distance off the road. On cross-questioning the discoverer, I found that he had been directed by the "gods" in a vision, to dig in a certain place, on the side of the hill near his house; where he was to find a valuable mine.

He accordingly made a huge excavation in the place indicated; and taking out a few cubic feet of ore (?) pulverized, and washed it, and smelted it with a little lead. The product of this fusion was the button of lead brought to me at Fukuyama. Thinking that the lead added might have originally contained silver, I secured a small sample for assay.

Subsequently on assaying the ore, apparently a partially decomposed slaty rock, I found that it contained no silver whatever, and on testing the lead added, I found only a small fraction of one per cent of the precious metal.

Under the circumstances, it is difficult to account for the silver in the specimen of lead brought to me, unless we suppose that the kind "gods," careful for their own reputation, caused a small piece of silver, perhaps as large as a ten cent piece, to drop from the man's sleeve while he was stirring the fire!

MUSA GOLD FIELD.

MUSA GOLD FIELD.

PROVINCE OF OSHIMA.

The history of this gold-field is exceedingly interesting. Mr. Nakano, my interpreter, while on the spot took the pains to collect the following traditions from the people of the valley.

It seems that in the second year of Genkiu, about six hundred and seventy years ago; a small boat, from the province of Chikuzen, was blown to sea, carrying off two sailors and their cook. This boat finally landed on the shore of Yesso, near Shiriuchi, where they waited for fair winds to return home. The cook, looking for water, found a bright lustrous stone at the foot of a waterfall, which excited his curiosity, and which he concealed from his companions, and took with him to his home in Chikuzen. At a convenient opportunity he gave this stone, which appears to have been a grain, or small nugget, of gold, to his master, a small daimio named Araki Daikaku. The daimio sent the nugget to the Shôgun, Yoriiye (the next in line to Yoritomo) who was then living at Kamakura.

This discovery of gold proved to be of sufficient interest, to induce the Shôgun to order Araki Daikaku to proceed to Yesso, taking with him the cook as a guide, to determine whether gold existed there in valuable quantity.

The Shôgun also rewarded the discoverer with a present of a thousand koku of rice, to which the daimio added a hundred and fifty koku from his own income, at the same time allowing him to assume the name of Araki Geki.

Araki Daikaku now engaged a force of eight hundred laborers, coolies and gold-washers ; with a sufficient body of military men for their defence, and a " Shugenja," or priest, to attend to their spiritual wants. The total number of men who sailed for Yesso was over a thousand.

The party left their native province on the twentieth day of the sixth month of the same year, (the chronology is very exact !) and landed at Yukoshi (near Shiriuchi ?) on the twenty-third day of the month following.

On landing, they built a castle on Kenashidake, and began to wash for gold.

They stayed thirteen years, washing first on a small stream near Shiriuchi, and afterward on the Musa river and its branches, obtaining a large amount of gold. They also built another castle for the quondam cook, Araki Geki, in a favorable spot at the foot of Kenashidake. The site of this castle is called Geki-no-yama to this day.

At this time the Ainos were a very savage and warlike race, and gave the gold-washers no little trouble. Finally the ill-feeling culminated ; and after a desperate battle, the Ainos became masters of the field ; killing the whole party of Japanese ; with the exception of the priest, who, with his family, was concealed by a friendly Aino. This solitary survivor died a short time after, but at the good old age of one hundred and five years.

The Ainos, emboldened by the victory, crossed the straits in large force, and made vigorous war on the Japanese. They were however finally defeated and destroyed by the Shogun's troops.

Since the massacre of these old gold washers, the field has been abandoned. The summer before our visit, the party of gold-washers from Fukuyama spent about sixty days in the valley, and washed out about eight *momme* of gold; (30 grammes, or about an ounce) which brought the field to the notice of the government.

On arriving at Ichinowatari, a few days were spent in making a preliminary survey of the river, and in washing for gold. Some difficulty was experienced in finding suitable places for testing the gravel, the Messrs. Araki having washed all that was easily accessible from the streams. The third day's prospecting developed gravel richer than any of the Toshibetsu, near the lower end of the field; and it was accordingly decided to undertake a more careful survey of the valley.

Gold Washing.—Samples of gravel were washed at the following places. In each case, unless otherwise stated, the sample represents the whole thickness of the bed of gravel, from the bedrock to the top. The barren layer of yellow sand or clay soil, which invariably covers the deposit, was not washed with the gravel; as it contains little or no gold, and would cause but little inconvenience, and a very slight additional expense, in washing the gravel on a large scale. Where the thickness is considerable it must of course be taken into account.

The gold-washing was done in the same manner as the year before, by a modification of the Japanese process; this method having proved so well adapted to the work. The only change this season, was to increase the amounts of gravel washed in each place; the maximum sample before being three cubic metres, this year four to eight cubic metres were treated. This involved two or three days work at each place, but the greater accuracy attained, quite compensated for the additional time required.

1. *Upper Musa.*—Among the first places visited was the upper part of the Musa valley beyond the region of the terraces. The river here runs between high hills of metamorphic rock, and the valley is quite narrow at the bottom. But little gravel is deposited here, and no suitable testing place could be found. One cubic metre of sand, from the river bank, was washed and yielded 1.7 milligrammes of fine gold, with one grain of medium size. Not a large yield, but as much as we should expect to find in such fine gravel, and interesting as an evidence of the direction from which gold is brought into the valley.

2. *Sumikawa.*—For the same purpose a sample was washed in the upper part of the Sumikawa valley, beyond the limits of the survey. The Sumikawa is an important branch stream, entering the main valley about a mile above our head quarters at Ichinowatari, and near the upper limit of the high terraces. This valley is somewhat wider than the upper valley of the Musa, and has a low river terrace bordering its banks. At the point tested the gravel was four and a half feet thick, and covered with about two and a half feet of common soil. The bed-rock is at the level of the stream. One and a half cubic metres of gravel, yielded eight and three tenths milligrammes of gold, or five and a half milligrammes per cubic metre. Gold of average fineness, containing some large grains.

3. *and* 4. *Sanjiurono.*—This terrace, 75 to 100 feet above the level of the stream, extends from Ichinowatari to the head of the main valley, on the south side of the river. About half of its area has been worked by the men from Chikuzen, and it was with some difficulty that we found small patches of untouched gravel, amidst the labyrinth of old workings.

The first place tested, at station (M. 1360 p,) is on the bank of the main river, a short distance below, and opposite, the mouth of Sumikawa. The bedrock here is about ninety feet above the river, and the gravel is about six feet thick, covered by yellow sandy soil and clay-rock pebbles three and eight-tenths feet thick. Two and a half cubic metres of this gravel, yielded fifty-five milligrammes of gold, or twenty-two milligrammes to the cubic metre. The gold is in rather fine grains.

The second place on this terrace (M. 1369 q.) is about four *cho* farther down stream, or about nine *cho* above Ichinowatari, and also on the top of the bluff bordering the river. The bedrock is sixty-three feet above the river, and the gravel about ten and eight-tenths feet thick, including the three or four feet of sand at the top. The general level of the terrace is about three feet higher. Seven cubic metres of gravel from this place yielded two hundred and thirty three milligrammes of gold, or about thirty two milligrammes per cubic metre. Gold very coarse, in flat grains, some weighing as much as thirty or forty milligrammes.

The results obtained at the two places on this terrace illustrate the value of washing large quantities of gravel. The gold-washers being sent out to "prospect" visited both places. From the first, they obtained very little gold, while from the second place, they secured one hundred and seventy one milligrammes, from but a small quantity of gravel. Yet the two places are about equally rich, as is shown by the more accurate results given above.

5. *Tsunaharino.*—Opposite Ichinowatari, on the north side of the river, is a large terrace called Tsunaharino. ("The rope stretching plain") extending to Gobansaka at the mouth of Tsunaharino-river. The bedrock here is about sixty-five feet above the level of the river. The gravel is only five feet thick, and is covered by four feet of sandy clay and one and a half feet of black soil. Total thickness, ten and a half feet. No stream large enough

for gold-washing crosses this terrace, so that it was difficult to test any of the gravel. A small quantity, one half cubic metre, was lowered to the main river and washed there, but proved exceedingly poor, yielding but nine-tenths milligramme of gold, or one and eight-tenths to the cubic metre. It seems hardly likely that it can be so very poor, but the old gold-workers have avoided this field, for only a few evidences of their work exist, and these apparently only prospecting holes.

An intermediate terrace, between this and the river, and fifteen to eighteen feet lower, may have been richer, for it is completely covered by old ditches and waste-heaps.

6. *Tsunaharinosawa.*—This sample of gravel was taken from the low river terrace, near the mouth of this stream, opposite the village of Gobansaka and near the main road from Hakodate.

This place was chosen by the assistant in charge of the gold washing that day, who probably misunderstood my instructions, as I expected him to take the gravel from the main terrace above. The gravel here has been derived from the main terrace, and concentrated by the action of the stream. The area of the deposit is small, and the thickness irregular. Where the sample was taken, the gravel is three and a half feet thick, and rapidly thins out to nothing, as the bedrock rises. The sample is therefore not a representative one, and of no use in determining the value of the field. Four cubic metres yielded 166.6 milligrammes of gold, or 41.7 milligrammes to the cubic metre. The gold is in coarse grains.

7. *Gobansaka.*—Above the village of Gobansaka, and above the main terrace, is a table land forming the boundary of the valley, and extending to Yunoshiri, the lower limit of the survey. The height varies, from two hundred and fifty to two hundred and seventy-five feet above

the river at Gobansaka—to one hundred and fifty feet above, at Yunoshiri. This high terrace (?) is in most places covered with gravel. A sample of two cubic metres, was washed on a small stream above Gobansaka, and yielded only seven and a half milligrammes of gold or three and three quarters milligrammes to the cubic metre. Grains of gold of average size.

8. *Masarisawa.*—A stream emptying into the main river, about opposite Gobansaka. The sample of gravel washed on this stream was taken from the main terrace some distance up stream, beyond the boundary of the old workings, and near the base of the foot hills. The gravel here is quite thick, twelve to fifteen feet, but proves to be quite poor. Seven cubic metres yielded but nine and seven-tenths milligrammes of gold, or one and four-tenths milligrammes to the cubic metre.

9. *Shikubeno.*—This terrace extends on the south side of the valley, from about opposite Gobansaka to Shikubeno-no-sawa. The bed rock is about fifty feet above the river, and the gravel is from ten to twelve feet thick, including three or four feet of yellow sand and soil. The sample of gravel was taken from the bank of a small stream, near the lower end of the field, where the Fukuyama gold-washers had been working the previous season, and from which place the greater part of their gold was obtained. Three cubic metres of gravel being washed, we obtained fifty-one and one-tenth milligrammes of gold, or at the rate of seventeen milligrammes per cubic metre. The gold was somewhat coarser than the average.

10. *Shikubeno-no-sawa.*—Two cubic metres of gravel, taken from a point in the upper part of this valley, though very carefully washed, yielded only a single small grain of gold weighing four-tenths milligramme, or at the rate of two-tenths milligramme per cubic metre.

11 and 12.—***Yunoshiri Terrace.*** In the lower section of the survey, where the river turns and flows northward, the main terrace is on the west side of the valley. The middle and east side of the valley are occupied by a large flood plain, quite low and in many places swampy. There is also in two places on the east side of the valley, between Shikubeno and Yunoshiri, a small terrace about forty feet above the river level.

The Yunoshiri terrace is quite narrow, in many places only about one cho wide. The bedrock lies from 80 to 85 feet above the river and the gravel is ten to thirteen feet thick, covered by six to ten feet of soil.

The first place tested, at station (M. 1376 s,) is on a small stream about nineteen *cho* above Yunoshiri. The gravel here is thirteen feet thick, covered by ten feet of soil. Eight cubic metres of gravel yielded about eighty one milligrammes of gold, or ten and one tenth milligrammes to the cubic metre. The grains of gold here are somewhat finer than the average.

The second place is on a small stream running across the terrace, about twelve *cho* farther down the valley, or about seven *cho* above Yunoshiri. The gravel here is somewhat thinner than that above, the whole thickness of the terrace being but sixteen feet. The level of the bedrock is about the same. Four cubic metres of gravel, yielded 37.7 milligrammes of gold, or 9.4 milligrammes per cubic metre. Grains of gold fine.

13.—***Yunoshiri.*** The richest place discovered within the limits of the survey, is at the end of the Yunoshiri terrace, just above the village. Probably an eddy was formed here by the meeting of the stream Yunoshiri with the main river, and so the gold was concentrated in this spot. The bed of gravel is quite thin (5 to 6 feet ?) the sample having been taken from a little point of terrace where the upper portion of the deposit had been washed away. Seven cubic metres of gravel from this place yielded one gramme twenty-six and a half milligrammes of gold or one hundred and forty-six and six-tenth milligrammes to the cubic metre. The last day's washing, two and a half cubic metres, yielded over six hundred milligrammes of gold, or at the rate of about two hundred and forty milligrammes to the cubic metre. One riū-tsubo would, at this rate, be worth eighty-eight sen, or about eleven cents to the cubic yard.

It is perhaps unfortunate that this rich deposit was found at this time (during the preliminary survey) for could I have known that it was the only one of the kind, and known also what the average value of the field would prove to be, I should certainly not have undertaken so large and complete a survey as I have now the honor to report.

14. *Minagoya.*—In order to determine the value of the field below Yunoshiri, beyond the limit of the survey, a sample of gravel was washed at this place, about a ri (2½-miles) farther down stream.

Below Yunoshiri the low river plain widens, and the main terrace becomes very small, only appearing here and there. The river terrace is largely composed of the debris of the soft clay rocks and shales, with thick beds of silt. The gravel of the upper terrace looks somewhat better.

The sample was taken from this upper terrace on the west side of the valley, near the village Hagisawa, and from the bank of the stream, Minagoya. Seven cubic metres of gravel yielded fifty-nine and one tenth milligrammes of gold, or at the rate of eight and four-tenths milligrammes to the cubic metre.

The following table give a summary of the results obtained at the different localities;

TABLE VI. MUSA GOLD FIELD. OSHIMA PROVINCE.

Sample of Gravel Locality.	*Grammes of Gold per Cu. Mtr.*	*Momme of Gold per Riu-tsubo.*	*Value of one cu. m. in cents.*	*Value of 1 Riu-tsubo in sen.*	*Value of 1 cu. yd. in cents.*
1. Upper Musa ... M 1329 f	0.0017	0.0027	0.10	0.60	0.08
2. Sumikawa O 231	0.0055	0.0089	0.32	1.89	0.25
3. Sanjiurono ... M 1369 q	0.0319	0.0517	1.89	11.50	1.44
4. Sanjiurono ... M 1360 p	0.0220	0.0357	1.31	7.93	1.00
5. Tsunaharino ...	0.0018	0.0029	0.11	0.65	0.08
6. Tsunaharinosawa O 153 r	0.0417	0.0676	2.49	15.04	1.88
7. Gobansaka ... M 1343 k	0.0038	0.0062	0.23	1.38	0.17
8. Masarisawa ... M 1347 o	0.0014	0.0023	0.08	0.51	0.06
9. Shikubeno ... M 1319 c	0.0170	0.0275	1.00	6.01	0.75
10. Shikubeno-no-sawa O 222	0.0001	0.0003	0.01	0.07	0.01
11. Yunoshiri Terrace M 1376 s	0.0101	0.0164	0.60	3.65	0.46
12. Yunoshiri Terrace M 1377 t	0.0094	0.0153	0.56	3.40	0.43
13. Yunoshiri ... M 1344 h	0.1466	0.2378	8.75	52.90	6.61
14. Minagoya ... M 1381 u	0.0084	0.0136	0.50	3.03	0.38

Omitting all results from the outskirts of the field, and taking only the more reliable of those obtained by the washing of large samples of gravel, on the main terrace; we will have the following series, arranged according to position, those of the upper valley first.

Locality of sample.	*Grammes of Gold to one cubic metre.*	*Value of one cubic metre cents:*
Sanjiurono M 1269 q	0.0319	1.89
Do. M 1360 p	0.0220	1.31
Shikubeno M 1389 c	0.0170	1.00
Yunoshiri M 1376 s	0.0101	0.60
Do. M 1377 t	0.0094	0.56
Minagoya M 1381 u	0.0084	0.50
Average	0.0164	0.94

These results are probably the most reliable, and will give the true average value of the field, as above. In English and Japanese units this average would be.

One *riu-tsubo* contains 0.0266 *momme* gold, worth 5.9 sen, or one cubic yard contains 0.2 grains of gold, worth 0.74 of a cent.

It will be noticed that the value of the gravel decreases from the upper end of the valley down stream, those from the head of the valley being richest (omitting the exceptional result obtained at Yunoshiri) and those nearest the sea, the poorest.

In conclusion, it seems hardly necessary to remark that these results show that neither the whole field, nor any large part of it, can ever be worked with profit at the present prices of labor. There is evidently a small area of ground near Yunoshiri, possibly as much as a thousand square metres, though probably much less, which will yield 8¾ cents per cubic metre; but there is no water convenient, and the gravel might have to be carried on pack horses, or by carts, to the stream below. It certainly would not be advisable to bring water, by a ditch, to this point, as the area of rich ground is too small to warrant such expense.

Topographical Survey.—In order to economize time, the survey was made on a plan, differing somewhat from that adopted in surveying the Toshibets field, the previous season. The exact area of the terraces being the important point to be determined, and the topography of the hills being of less consequence, the following plan was adopted.

Signals marked by small flags were established on the tops of the hills. The "main line" was run on the terrace with the transit, its course being so selected as to take advantage of the best ground, and bending several times to follow the windings of the valley. The distances were measured with the telescope by stadia-rod as usual. From this line; the terrace being quite free of bamboo, and having but narrow belts of trees in places; the signals on the hills were readily seen, and their positions determined by sights with the transit, from convenient points, three or more such "cuts" being taken on each signal.

The main river, and some of the smaller streams, the roads, and the outlines of the terraces and old workings; were run by prismatic compasses, with paced distances; and the work connected as often as possible with the main line, or the signals determined therefrom. When it was impracticable to make such connections, as in the upper parts of the small branch streams; sights taken on three or four signals, from convenient points, with the compass; served a very useful purpose as a check.

Leveling.—The main line, and other important lines of the survey, were leveled by hand levels with a "speaking" rod (read by the surveyor himself at short distances). The heights of the hills were determined by trigonometrical leveling, the angles of elevation being read by the transit.

In the upper part of the field it was found impracticable to run a "main line" from which the signals on the hills could be seen. This part of the valley was therefore surveyed by triangulation, signals being determined both on the hills and on the terraces. A section of the main line was used as a base and some of the old signals served as checks on the accuracy of the work. The paced lines run by prismatic compass; in this portion of the survey were checked by connections with the signals on the terrace, but more often by cuts taken on three or more signals on the hills.

In this section of the survey I had the opportunity of comparing the lines of hand-leveling, with the levels obtained by vertical angles read with the transit. The agreement proved quite satisfactory. In a long line, of nearly two miles, leveled by hand, the total error wa. 1.5 feet; and at intermediate stations, the discrepancy was about the same, except in one instance where it reached 2.2 feet. This would not do, perhaps, for railroad or canal work, but for our purposes it is quite accurate enough, these discrepancies being within the probable error of the trigonometrical leveling itself.

Mapping.—The map was drawn on a scale of $\frac{1}{5000}$. In plotting the work of the transit, the "cuts" in the hills proved to be quite as accurate as it was possible to draw them, and the three or four lines almost invariably passed through the same point, or where a triangle of error was formed it was of insignificant size. This work both in the field, and in the office, was done by Messrs. Nakano and Inagaki, and speaks well for their care and skill. The compass surveys were checked so often by closing on the main line and signals—that as plotted on the map they cannot be greatly in error at any point The "cuts" taken with the compasses, proved of great value; the true position of points on the paced lines, being thus determined with great accuracy. Finally after the lines of the survey were inked, and the contours drawn from sketches in the note books, the sheets of the map were taken into the field and corrected by actual comparison with nature.

The surveys of the outlines of the terraces made it possible to draw them with some accuracy—and the map represents truly the size of the gold-bearing portion of the field.

Upon examination of the map we find; excluding the poorer ground of the hills and high table lands, and that of the tributary valleys; the total area of the gold field, within the limits of the survey, to be

7,975,000 square metres.

of this the area of the low bottom land, including the river bed and adjoining flood plains, will be about

3,875,000 square metres.

and the remainder.

4,101,000 square metres,

is the area of the main terraces. Of this an area of about

868,000 square metres

is covered by old workings, leaving a total.

3,233,000 square metres

of untouched terrace, available for gold washing, with an average thickness of 2.4 metres of gravel.

The old workings are confined to the upper part of the valley, being most abundant where the gravel proves to be richest.

It will interesting to calculate, how much gold the party of gold washers from Chikuzen, must have obtained from this part of the field. Taking the average thickness of the gravel at 1.8 metres we will have something over a million and a half cubic metres of gravel, represented by the area covered by these old workings. Multiplying this by the average value of one cubic metre in this part of the field, say 1.4 cents, we will have, as the total amount of gold obtained by Mr. Araki, a value of twenty-one thousand dollars (21,000 *yen*) representing a weight about nine of and a half thousand *momme*. (114. oz. gold.)

Let us suppose that six hundred of the eight hundred coolies were working continuously at this place, and that they worked two hundred and fifty days per year, each washing three cubic metres of gravel per day. At this rate they would wash 450,000 cubic metres of gravel per year, and it would require three years and a third to to complete the work. This estimate of the amount of to labor be had from six hundred coolies, is extremely liberal, and and if we add the time taken to dig ditches, and to perform other unprofitable work, it is likely that the time will be more nearly four or five years.

We might continue this calculation and prove that the Messrs. Araki must have obtained about two thousand momme of gold per year, or at rate of about twenty-six hundred momme in the thirteen years of their stay. It becomes evident that they must have worked in other places, than in this part of the Musa Valley ; and very possibly the Matsumai field may prove to have been washed by them.

TOKACHI GOLD FIELD.

THE TOKACHI GOLD FIELD.

The attention of the Kaitakushi was directed to this gold field, by the statements of an officer of the Boussankioku, who reported having washed a large quantity of gravel on the sea-shore in the vicinity of the Tokachi river, on the east coast of the island. The results obtained by this officer indicated a gold field of extraordinary richness. Unfortunately I have not been able to secure a copy of his report, but have heard on good authority that he obtained $\frac{1}{30000}$ part of gold from a weighed quantity of gravel. This, if correct, would equal thirty three and a third grammes per ton, or about sixty six and two thirds grammes, per cubic metre. Assuming the gold to be of the same fineness as that of the Toshibetsu, this would be equivalent to nearly forty dollars per cubic metre!

After leaving the Musa gold-field we proceeded to the scene of this remarkable discovery; the verification of which, promised to be truly refreshing, after the sight of so much gravel, yielding but one or two cents to the cubic metre.

The journey, though long and fatiguing, was not without interest, but the description of the country, and the geological facts collected, must be deferred to another time and place.

The deposit of gravel, which forms the Tokachi gold field, was was first met with at one *ri* beyond Samani, near Uragawa, in the province of Hitaka; and on the south-west side of the prominent range of mountains of metamorphic rock, which terminate in the promontory of Erimo, at the south east corner of the island.

The gravel is here about forty or fity feet thick, and forms nearly the whole height of the marine terrace. This bed of gravel is usually underlaid by a dark blue slaty rock, which is readily decomposed, and forms in places a large proportion of the gravel. This slate seems to contain a little gold. A sample of slate debris, unmixed with other gravel, was tested, being taken from the bed of a small stream, Shimichikayopu, which runs through the metamorphic rock, between Samani and the place of the first appearance of the drift. One half cubic metre of this slate yielded four and one tenths milligrammes of gold, or eight and two tenths milligrammes to the cubic metre. The quantity of decomposed slate available is very small, even were it rich enough to pay for treatment. There is of course, an inexhanstible supply of the solid, undecomposed slaty rock, but probably even poorer than the gravel.

A sample of gravel from the bed of drift, was tested on the Sannishibe, a small stream a short distance east of the Shimichikayopu. The gravel is here composed of hard laminated sandstones, mica schist, quartzite, slate, etc., and contains a large proportion of quartz pebbles. The bedrock is the same partially decomposed, slate like rock, here filled with numerous thin quartz seams and small veins. The gravel contains a large proportion of this slate, being in places quite blue in consequence.

Two cubic metres of gravel, taken from the bedrock upward, in a favorable place about thirty cho (2 miles) up stream; yielded but one or two small grains of gold, too small to be weighed. This result would seem to indicate that the gravel of the drift deposit, merely dilutes the debris of the blue slate, and probably owes all its gold to the blue gravel which it contains.

On one or two small streams in this vicinity I observed doubtful evidences of old workings. So it may be, that some of this gravel is richer than that tested, though not likely to be rich enough to be now worked.

Between Samani and Horoidzumi we cross a range of mountains parallel to the main range, and like that, composed of metamorphic rock. The bed of gravel rises gradually with the slope of the mountains, to a height of about three hundred feet above the sea; preserving nearly the same thickness, forty or fifty feet, as before, and forming in places, extensive table lands on the flanks of the hills. Several fine sections are exposed on the seacoast. High bluffs of metamorphic rock, covered at the top with this thick bed of stones and gravel, presenting a face seemingly as perpendicular as the wall of rock itself. The occurrence of this bed of gravel, thus raised in the hills, seems to point to a recent elevation of this range, since the deposition of the drift.

Horoidzumi is on a marine terrace of some extent made up entirely of drift, and surrounded by metamorphic mountains. There are two sea terraces here, one perhaps fifty feet above the sea, and the other one hundred and fifty to two hundred feet.

A sample from this upper terrace was washed on Abiakisawa, a small stream twenty five or thirty *cho* north-east of Horoidzumi, and at a point about ten *cho* from the coast. The bedrock, dark blue argillite and quartzite, is here about twenty five or thirty feet above the stream, and the gravel ten feet thick, covered by two feet of black loam. A large quantity of gravel, not measured, but between three and four cubic metres, was taken from the top of the bluff and washed in the stream below. Although great care was exercised in the washing, no gold was obtained, but only the usual iron-sand, which in this case was both abundant and coarse.

Another sample was taken from the side of a small ravine near Nochinai, about half a *ri* north-east of Horoidzumi and very near the shore. The bedrock of this lower terrace was nowhere seen, and the gravel is from forty to fifty feet thick, forming the whole height of the terrace. We washed here about one cubic metre of gravel, but without obtaining any gold. The iron sand was quite coarse.

Between Horoidzumi and Saruru we crossed the main range of mountains, composed of mica-schists gneiss, granite, quartzites, etc., and having a northwesterly trend.

Saruru, in the province of Hitaka, is at the mouth of a river of the same name. In descending the valley several terraces, covered with promising gravel, were noticed. Four small samples of this gravel from different places, were afterwards carefully tested for gold, but proved barren ; and finally a sample, measuring about half a cubic metre, was secured from a hollow in the bedrock, near the head of the terraced portion of the valley, under conditions which would usually assure a very large yield. The sample being washed with care, no gold whatever was found.

From Saruru we went to Birō, the principal town of the province of Tokachi. Birō is situated on a high marine terrace on the coast, and a short distance north of the last range of foot hills of the mountain range. The terrace is almost wholly made up of gravel, in places fifty or sixty feet thick. About one cubic metre of gravel, not measured, was washed on the Birō river, but no gold was obtained.

Securing a guide at Birō, we went on to Berufune, near which place Mr. Enomoto washed for gold the year before. The gravel here, is like that of Birō, though containing a very small proportion of quartz in addition The bedrock is probably far below the level of the sea as it is nowhere to be seen, and as the terrace is here quite low, having decreased in height from Biro.

At Ayoboshuma, one *ri* from Berufune, or about six *ri* north of Biro, the place reported to be so very rich, the gravel is only about twenty-five to thirty feet above the sea, and is covered by a few feet of yellow sand. The gravel is composed of blue metamorphic quartzites and slates, and a small percentage of granitic rocks, with still less quartz, though more than at Berufune. The bedrock was not seen. The guide showed us about the place from which Mr. Enomoto took the sample of gravel, which yielded so much gold; but the wind and tide had obliterated all trace of his work. A place was chosen in the immediate vicinity; but at a lower level, as it was desired to push the excavation as near as possible to the bedrock. Three cubic metres of gravel were washed; taken from eighteen feet above, to four feet below the surface, from every part of the bed. Thus a thickness of twenty two feet was tested, the lower portion of which was far lower than any depth that Mr. Enomoto could have attained, at the place from which his sample was taken. This gravel was washed in a little stream issuing from springs in the bank, and flowing over the shore. The large stream near by, being both too deep and too sluggish.

These three cubic metres of gravel, yielded about twenty grains of gold; many of which were so minute as to be seen with difficulty, even with a strong lense; and all being exceedingly fine. These grains together weighed only six-tenths of a milligramme, or at the rate of two-tenths of a milligramme per cubic metre. Expressed fractionally this would be the

$\frac{1}{10,000,000,000}$ part

by weight, of the gravel tested!

Another smaller sample was taken from this same locality, as nearly as possible from the exact place worked by Mr. Enomoto last year. But with no better result.

Near the mouth of the Tobui river, one *ri* beyond Ayoboshuma, or about seven *ri* (17 miles) from Biro northward, there is an exposure of bedrock, a clay rock here forming the bank of the river. A specimen of gravel, about one quarter cubic metre, taken from the surface of this bedrock, yielded upon being washed two microscopic grains of gold, so small as to be unweighable.

The following table gives a summary of the results obtained from the different localities in which this deposit of drift was tested, beginning at the northernmost.

TABLE VII.—TOKACHI GOLD FIELD.

Place.	*Grammes of Gold per cubic metre.*	*Value of 1 cu. metre in cents.*
Tobui river, Tokachi Province	0.0001	0.01
Ayoboshuma, „ „	0.0002	0.01
Biro river, „ „	nil.	nil.
Saruru river, Hitaka Province	nil.	nil.
Nochinai, „ „	nil.	nil.
Abiaki river, „ „	nil.	nil.
Sannishibe, „ „	trace.	nil.
Shimchikayopu* „	0.0082	0.50

From these results it is evident that this deposit of gravel, which covers so large an area in these two provinces, is nowhere rich enough to pay the expense of washing, and that even the occurrence of the minute proportion of gold found is quite exceptional. It is however quite possible, that had the concentrated iron sand from each place, been scrutinized with the care observed at Ayoboshuma; an equal quantity of gold might have been collected at some other places, for such microscopic grains are very easily overlooked.

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* From decomposed slate.

In view of these results it seems, therefore, not a hazardous supposition, to imagine that the gold washers, employed by Admiral Enomoto, men living in Hitaka province, either thinking to please him, or for some other object, such as the hope of employment from merchants or other gold-seekers; quietly dropped the gold sand in question into the gravel during the operation of washing! I have not been able to examine the gold obtained, but am informed that it is quite unlike the gold of Yesso, and resembles very strikingly the gold sand of the island of Sado.

Five or six years ago, some merchants from Hakodate, attracted by rumors of gold in this vicinity, began to work the gravel between Berufune and Ayoboshuma, but soon abandoned the attempt, undoubtedly finding the ground too poor. It is supposed that they dug the ditch which crosses the terrace here, probably to take water from the upper part of the Ayoboshuma valley.

In concluding this report I take pleasure in acknowledging the services of the officers and student-assistants, who have been associated with me in this work, who have cheerfully undergone fatigue and hardship, and who have so creditably performed the work committed to them

The following gentlemen have assisted me in this work :—

Season of 1873.

Mr. Ijichi, Suyemasa, Paymaster.
Mr. Sato, Hideaki, Interpreter and Assistant.
Mr. Inagaki, Tetsunoshin, Student Assistant.
Mr. Misawa, Shijō, „ „
Mr. Kada, Sadaichi, „ „
Mr. Saka, Ichitaro, „ „

Season of 1874.

Mr. Machida, Sanetomo, Paymaster.
Mr. Nakano, Toshio, Interpreter and Assistant.
Mr. Kubota, Masafusa, Draughtsman,
Mr. Inagaki Tetsunoshin, 1st Student Assistant.
Mr. Takahashi, Jōzō, Student Assistant.
Mr. Saito, Takeharu, „ „
Mr. Mayeda, Semei, „ „
Mr. Shimada, Junichi, „ „

It would be difficult to single out for praise any one of these, so well have all done their work; so I must be content with this general acknowledgement of their services.

Respectfully submitted,
HENRY S. MUNROE.